Assignment 2: Temperature Distribution

Collaboration Policy

You may not use code from any source (another student, a book, online, etc.) within your solution to this assignment. In fact, you may not even look at another student's solution or partial solution to this assignment. You also may not allow another student to look at any part of your solution to this exercise. You should get help on this assignment by coming to the instructor's or TA's office hours or by posting questions on Piazza (you still must not post assignment code publically on Piazza.) See the full Course Collaboration Policy here: Collaboration Policy

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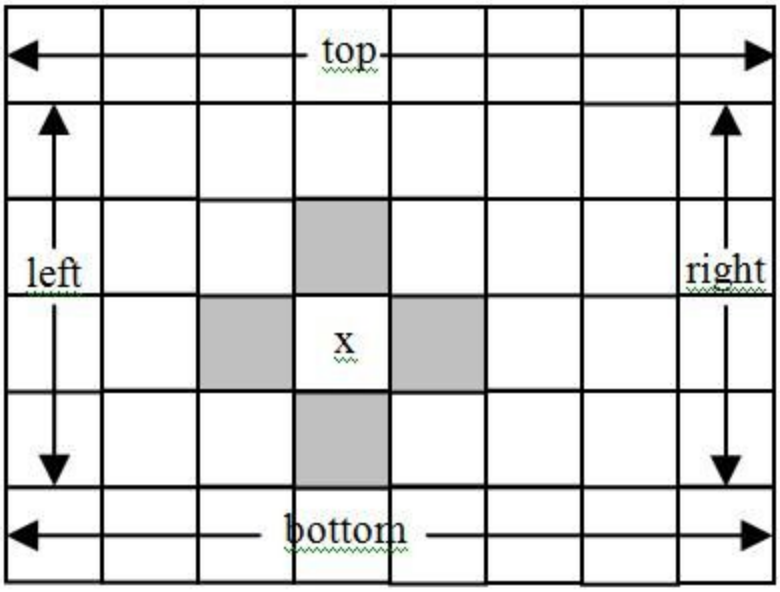
Assignment specs:

The temperature distribution in a thin metal plate with constant (or isothermal) temperatures on each side can be modeled using a two-dimensional grid, as shown in the figure below. Typically, the number of points in the grid are specified, as are the constant temperatures on four sides. The temperatures of the interior points are usually initialized to zero, but they change according to the temperatures around them. Assume that the temperature of an interior point can be computed as the average of the four adjacent temperatures; the points shaded in the grid below represent the adjacent temperatures for the point labeled x in the grid. Each time that the temperature of an interior point changes, the temperatures of the points adjacent to it change. These changes continue until a thermal equilibrium is achieved and all temperatures become constant.

Submit to R'Sub (galah.cs.ucr.edu) your source code in a single file named main.cpp. Do not submit any other files.



Basic algorithm:

1. Get from the user the names of the input and output files.
2. Read from the input file the initial temps for top, right, bottom, and left sides of plate.
3. Read from the input file the tolerance for equilibrium.
4. Initialize the edges of the 2D grid with initial temps you got from the input file, and initialize the inner cells of the grid to 0.0.
5. Continue updating temperature values within inner cells until equilibrium is reached.
6. Output to the output file the values of the inner cells of the grid after equilibrium obtained.

Step 5 details

- When updating the grid's temperatures always start at the top, left inner cell and update that row before updating the row below it. So, the first cell to be updated will be grid[1][1], then grid[1][2], and so on.
- Never change an edge cell's temperature.
- A cell's new temperature will always be the average of the 4 cells adjacent to it, the cells immediately above, below, left, and right of the cell.
- You should update all inner cells of the entire grid, while always keeping track of the largest difference between the old value and the new calculated value for a cell. Once you have completely updated the grid, if your max difference is within the tolerance level, equilibrium has been reached. You are done. Go ahead and output the temperatures in each cell of your grid. If not, you need to update the entire grid again.
- You are required to use 2D arrays, NOT vectors, for this assignment.
- The grid dimensions will always be the same as the grid example above (6 X 8).

Input/Output File Specifications

Your program must read in from the user the names of the input and output files. Ask for the name of the input file first.

Input File

The input file will have the 4 starting temps on one line, each separated by a space and the tolerance on the second line.

```
29.0 45.0 0.0 15.0
0.5
```

Output File

When completed, the output file should list the temperatures of the inner cells only:

```
20.6404   22.6151    23.944   25.7453   28.7711   34.1826
16.4471   17.5668   19.1289   21.8528   26.5254   34.0902
13.1644   12.8385   13.9106   16.6151   21.7503   30.7639
8.81194    7.2602   7.58734   9.35255   13.3295   22.2734
```

Here is a second example.

Input file contents:

```
34.5 32.1 45.9 4.2
0.3
```

Output File:

```
21.0316 28.2423 31.6891 33.3264 33.8764 33.5413
17.4695 26.1208 31.0538 33.5311 34.3179 33.7525
18.8504 28.1225 33.2614 35.7263 36.2895 35.1051
25.8502 34.5454 38.411 40.025 40.1232 38.3071
```